MODIS Quarterly Report
Snow and Ice Project
Reporting Period: January - March 1997
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SUMMARY

Field work was conducted in conjunction with the MODIS MAS Winter Cloud Experiment (WINCE) experiment in New Hampshire, New York and Wisconsin during the month of February 1997. MODIS Airborne Simulator (MAS) and passive-microwave measurements were acquired. Software was delivered to the SDST for the snow and sea ice algorithms. Progress has been made in completing development of the sea ice surface-temperature algorithm. Modifications are being made to the snow-mapping algorithm in order to allow more snow to be mapped in densely-forested areas. Error analysis is on-going to determine the accuracy of the snow-mapping algorithm in various land covers. Two papers have been submitted for publication, and two papers are in preparation.

FIELD WORK

Field work was conducted in conjunction with the MODIS MAS Winter Cloud Experiment (WINCE) experiment in three different areas. Field measurements were conducted by D. Hall and Klaus Bayr and students from Keene State College in Keene, NH, in conjunction with a NASA ER-2 overpass on 10 February 1997. On February 9, 1997, MODIS Airborne Simulator (MAS) Data was acquired over central New York State as part of WINCE. During the overflight, Andrew Klein/USRA, Alex Moore and Carrie Brindisi of Hartwick College and Joan Ramage of Cornell University conducted a field survey of snow conditions in Hartwick College's Pine Lake ecological reserve. Prior to the overflight, arrangements were made with Landcare Aviation of Onedia, NY, to provide high resolution aerial photography of the study site. The field data and aerial photography will be used to validate the snow map produced from the MAS data using the MODIS snow-mapping algorithm. The validation research will continue when the MAS data become available.

Additional field measurements were conducted by D. Hall, J. Foster and A. Chang, all of code 974, on 15 February 1997 in southern Wisconsin, simultaneous with an ER-2 overpass and overflights of the NOAA planes collecting gamma-ray data for use in determining snow depth. On-board the ER-2 was the MAS and the MIR.

SOFTWARE DELIVERY

Version 1 of the MODIS algorithms for MOD_PR33, eight day composited snow product, MOD_PR29, swath sea ice product, MOD_PR29A, daily sea ice product, MOD_PR42, eight day composited sea ice product were delivered to the MODIS Science Data Support Team by George Riggs/RDC and Hugh Powell/GSC. Deliveries included source code of the algorithms, product specificiations, data files, supporting files and documentation.

In-lab IDL procedures were developed for extraction and examination of data from HDF files in support of development and testing of MODIS data product algorithms and to support investigation of the quality assurance (QA) of the data products (input and output files) and checking of contents for conformance with data product specifications. These
procedures are the beginning of a suite of in-lab QA tools to support routine QA of data products during development and in the post-launch period.

George Riggs/RDC, Dorothy Hall/974 and Andrew Klein/USRA participated in the MODLAND-SDST meeting, 18-20 February 1997 at GSFC. Issues of QA, algorithm coding standards, data product specifications and Version 2 issues, requirements and delivery schedules were discussed. A minimal MODLAND QA data plan was hammered out.

Development of the MODIS sea ice algorithm continued using the MODIS Airborne Simulator (MAS) as the prototype for MODIS. The MAS cloud mask data product, the prototype of the MODIS cloud mask, was integrated into the sea ice algorithm. Analysis of information contained in the cloud mask product and of the cloud tests applied in a polar ocean situation was undertaken to determine “best” use of the cloud mask for sea ice
identification. Several C programs were written to extract and analyize information from the 48-bit cloud mask.

Use of several variations of an ice surface temperature (IST) technique was conducted for determining IST in the MODIS sea ice algorithm. Vartiations of the IST technique were analyzed for effects of equation forms and coefficients on calculation of ice surface temperature.

George Riggs and Hugh Powell submitted Version 2, Revision 0 drafts of the MODIS snow data products MOD10 L2 (swath) , MOD10A L3 (daily snow grid), and MOD10C1 L3 (daily climate modeling grid) to the SDST.

ALGORITHM DEVELOPMENT

Landsat Thematic Mapper (TM) images of Glacier National Park and the BOREAS Southern Study Area near Prince Albert National Park, Saskatchewan were analyzed by Andrew Klein to investigate how the reflectance of snow-covered and snow-free forests differ. Analysis of summer and winter images from both sites suggests that a combination of the Normalized Difference Snow Index (NDSI) and Normalized Difference Vegetation Index (NDVI) may improve the accuracy of the snowmap algorithm.

In conjunction with the remote sensing, a modeling study was undertaken. The purpose of the modeling was to aid in understanding the mechanisms responsible for the observed reflectance changes and to help test the hypothesis that a combination of NDSI and NDVI may improve snowmapping accuracy. In the study, two reflectance models, a snow reflectance model (code developed by Jeff Dozier, UCSB) and a forest canopy model (GeoSAIL) developed by K.F. Huemmrich in code 923, were coupled to create a reflectance model of a snow-covered forest. The model was used to investigate how the reflectance of a forest stand is affected by changes in snow grain size, solar-illumination angle, canopy cover and canopy type. The modeling was in agreement with the satellite observations and helped provide a basis for selecting classification criteria.

The major results of the study were (1) a combination of NDSI and NDVI should allow more accurate classification of snow-covered forests and (2) a threshold in a visible wavelength should be used for coniferous forests in which the visible reflectance is too low to be considered snow-covered.

Other algorithm-validation work showed that the current algorithm is capable of mapping snow cover in central Alaska when the vegetation-cover density is about 50% or less. Overall, the accuracy of the snow-mapping algorithm is 85% for a 13 April 1995 MAS scene with a variety of land-cover types. These results come from the MAS data that were acquired in April of 1995 in central Alaska. It is hoped that with a modified algorithm, as described above, snow will be mapped in forests with densities of >50%, and that the accuracy of snow mapping will improve accordingly.

WEB PAGE

A Home Page and associated Web pages were developed for the MODIS snow and ice project. The Web pages are nearly complete. The address is: http://ltpwww.gsfc.nasa.gov/MODIS_Snow/modis.html

PUBLICATIONS

In press:

Hall, D.K., J.L. Foster, A.T.C. Chang, C.S. Benson and J.Y.L. Chien, in press: Determination of snow-covered area in different land covers in central Alaska from aircraft data - April 1995, Annals of Glaciology.

Polissar, A.V., P.K. Hopke, P. Paatero, Y.J. Kaufman, D.K. Hall, B.A. Bodhaine and E.G. Dutton, submitted: Long-term trends and seasonal variations of aerosol concentration at Barrow, Alaska, Journal of Geophysical Research.

In preparation:

Klein, A.K., Hall, D.K., Riggs, G.A, Improving snow-cover mapping in forests through the use of a canopy reflectance model, in preparation for submission to Hydrological Processes.

Riggs, G.A. et al., Sea ice identification with the Moderate Resolution Imaging Spectroradiometer Airborne Simulator (MAS).